ADA Technologies, Inc.

Recovery of Mercury

Technology Need:

Mercury was widely used in the Department of Energy's (DOE's) weapon-making facilities, primarily because of its radioactivity shielding properties and its ability to dissolve lithium in the separation of lithium-6 (Li^6) from lithium-7 (Li^7). This broad use of mercury has created a wide range of mercury-contaminated wastes and wastewaters. Technologies are needed to help sites meet the stringent limits for mercury.

Technology Description:

ADA Technologies, Inc. has developed a process whereby dissolved mercury is selectively removed from wastewater streams. The process is based on the sorption of mercury on specialty sorbents, regeneration of the sorbent by thermal means, and recovery of the desorbed mercury in a recyclable form. ADA holds a patent on a similar process for removing mercury from off-gases (US 5,409,522, April 25, 1995) and has tested it under conditions typical of municipal waste incinerators. ADA has adopted the name "Mercu-RE" to describe its process.

Pilot-Scale Unit at Oak Ridge Outfall 200, Y-12 Plant

ADA's process is based on the sorption of mercury on specialty sorbents and the regeneration of the sorbent by thermal means, recovering the desorbed mercury as liquid elemental mercury. This process removes dissolved mercury from liquid waste streams by selective sorption utilizing a noble metal sorbent. The process is based on selective sorption of dissolved mercury (in both elemental and ionic forms) by a noble metal, such as gold or silver. Mercury readily dissolves into noble metals and is thereby selectively removed from the liquid stream. The noble metal is dispersed on inert support particles, such as microporous alumina or carbon. Selective removal of mercury is achieved by passing the contaminated liquid through a fixed bed containing the noble metal sorbent.

The sorbent material, when loaded with mercury to the point of breakthrough, can be thermally regenerated. The spent sorbent is regenerated by heating, first to drive off residual water and then to drive off the mercury. A small flow of purge gas carries the desorbed mercury to a condenser where the liquid mercury is recovered. The liquid mercury can be recycled provided there is no radiological contamination.

The ADA sorbents have shown the following characteristics based upon testing:

<The sorbents take up more than 10 percent of the noble metal weight in mercury at high mercury solution concentrations

<Sorbent samples had a crystallite size below 60 nm, which was considered the maximum size for efficient use of the noble metal

<The sorbent was thermally stable up to a temperature of 700EF, which is the maximum regeneration temperature

used by ADA in this process

<Synthesis of 0.9 kg batches of sorbent proved to be reproducible based on duplicate isotherms

<Isotherm testing was performed using a surrogate DOE wastewater and the mercury concentration was reduced from 210 parts per trillion (ppt) to 0.5 ppt in several samples

<Isotherm testing using a surrogate DOE wastewater with an initial concentration of 1000 ppt mercuric chloride resulted in 99.9 percent removal efficiency and final concentrations of less than 1 ppt.

<Regeneration tests performed showed that the time and temperature required to remove 99 percent of the mercury from the sorbent is 48 hours at 370EC.

Benefits:

<Sorbents are selective for mercury and can be thermally regenerated for reuse

<Liquid mercury can be recovered in its elemental form

<Minimal or no secondary wastes are generated

<Field unit successfully removed Hg from the stream down to sub-ppt levels

<Commercial applications, including dental waste waters, and public treatment works/municipal sewage

Status and Accomplishments:

ADA manufactured a mini pilot-scale field unit that demonstrated successful treatability of the East Fork Poplar Creek, Outfall 200 at the Oak Ridge National Laboratory Y-12 Plant. The mini field unit successfully removed Hg from the stream down to sub-ppt levels of approximately 0.6 to 1.5 ppt, from an initial stream concentration of 1000 ppt.

Four new sorbents were developed under this contract and three of these were field tested on contaminated creek water at the Y-12 Plant. Two of these sorbents successfully demonstrated very high removal efficiencies for soluble mercury species, reducing mercury concentrations at the outlet of the pilot-scale system to less than 12 ppt, for as long as 6 months. The other sorbent tested at the Y-12 Plant targeted colloidal mercury not removed by standard sorption or filtration processes. At the Y-12 Plant, colloidal mercury appears to be associated with iron, so a sorbent that removes mercury-iron complexes in the presence of a magnetic field was evaluated. Field results indicated good removal of this mercury fraction from the Y-12 waters.

A fourth sorbent was developed but it was determined that this sorbent did not meet DOE needs. The contract with ADA was concluded in March 2000.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 1703
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

For additional information, please visit ADA's website at http://www.adatech.com/